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**Ishii et al.**

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(54) **DISPLAY APPARATUS**

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(30) **Foreign Application Priority Data**

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(57) **ABSTRACT**

A display apparatus provided on a surface of a panel, the display apparatus includes a quadrangular window section provided in the surface, an image display surface disposed in and recessed from the quadrangular window section, a frame configured to surround the image display surface and extend from the image display surface to the quadrangular window section, in which the frame includes an inside edge formed in a substantially trapezoidal shape having a shorter upper edge and a longer lower edge, and an outside edge formed in a quadrangular shape conforming to the quadrangular window section, in which a difference in length in a lateral direction between the shorter edge of the inside edge and an upper edge of the outside edge is set larger than a difference in length in the lateral direction between the longer edge of the inside edge and a lower edge of the outside edge.

(51) **Int. Cl.**  
**B60K 35/00** (2006.01)

(52) **U.S. Cl.**  
CPC ..... **B60K 35/00** (2013.01)

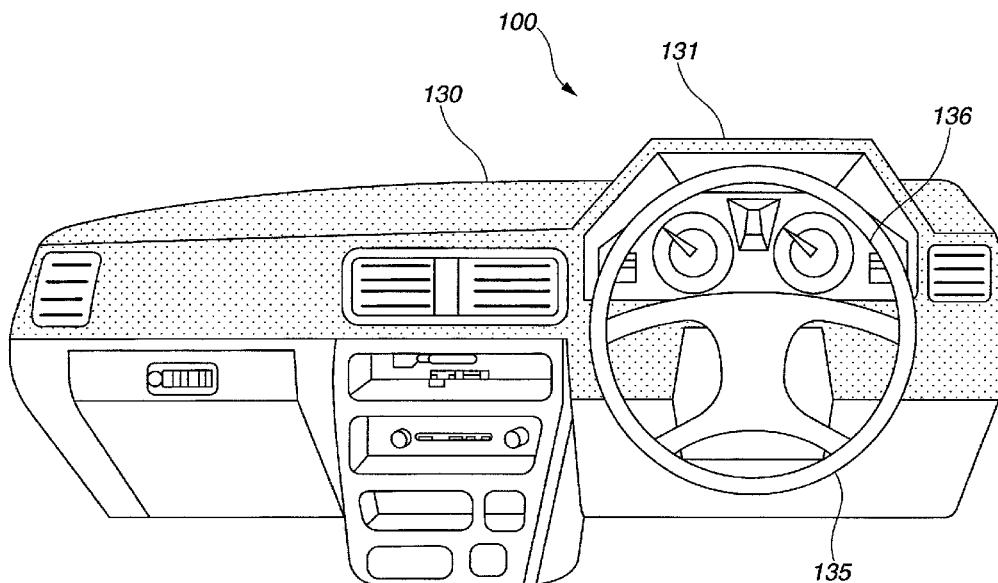
(58) **Field of Classification Search**  
CPC ..... B60K 35/00  
USPC ..... 348/148, 143, 118, 113, 144  
See application file for complete search history.

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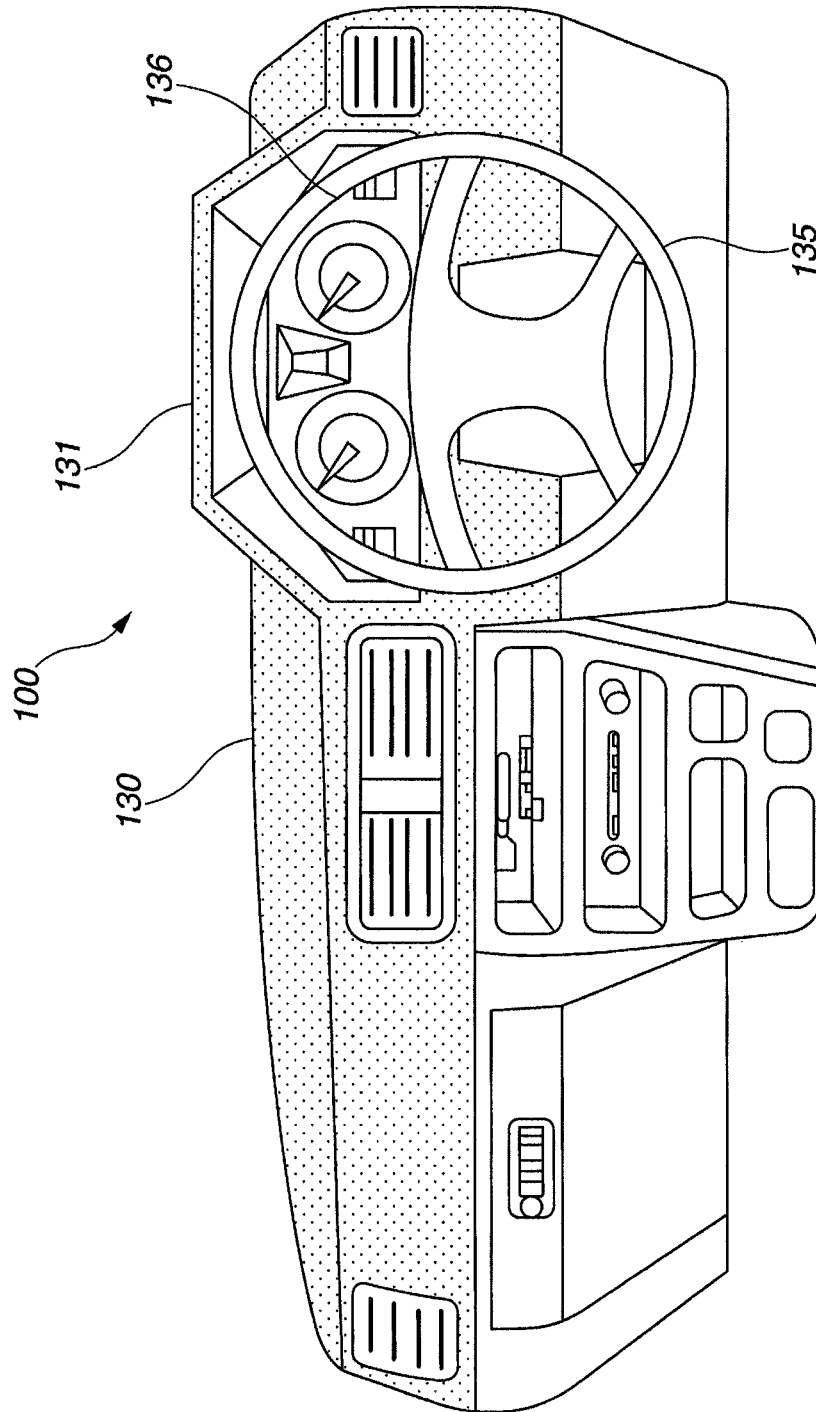
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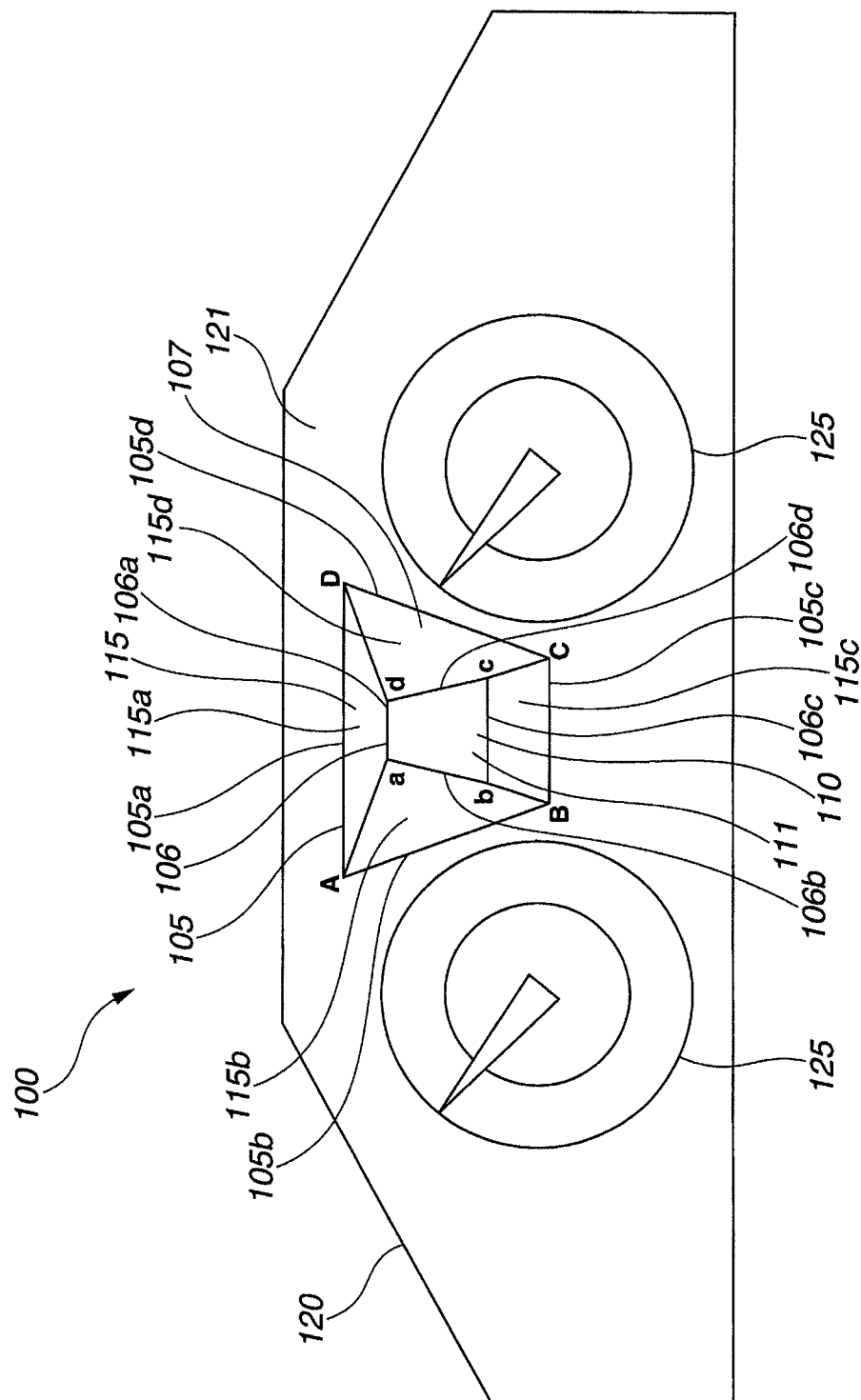
**20 Claims, 5 Drawing Sheets**



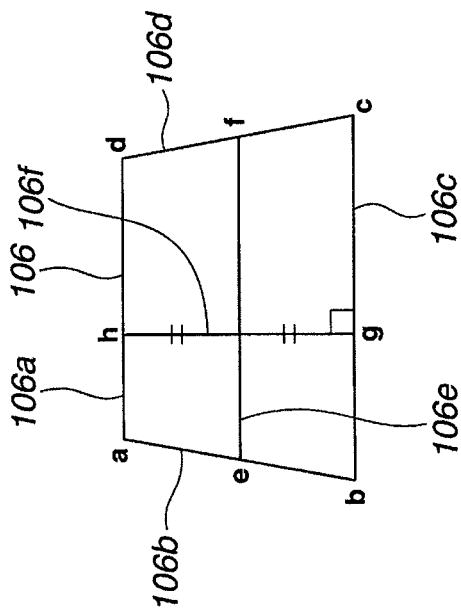
**FIG.1**



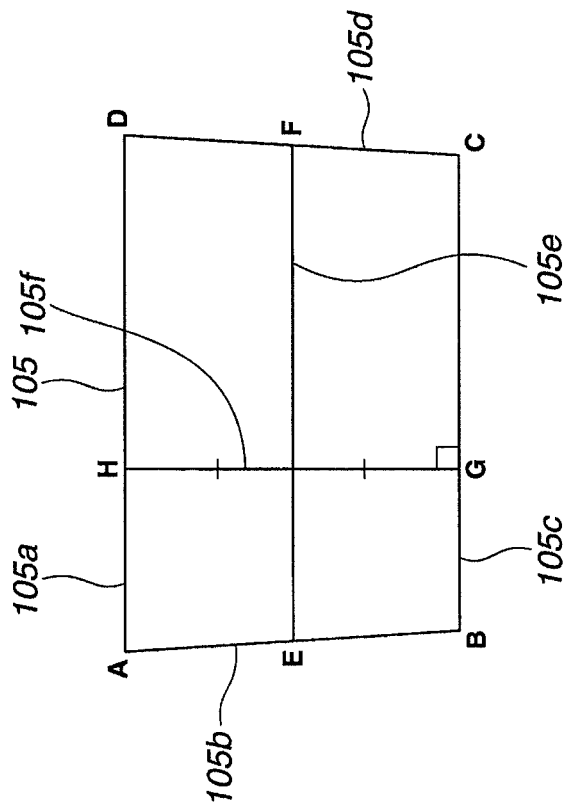
**FIG. 2**



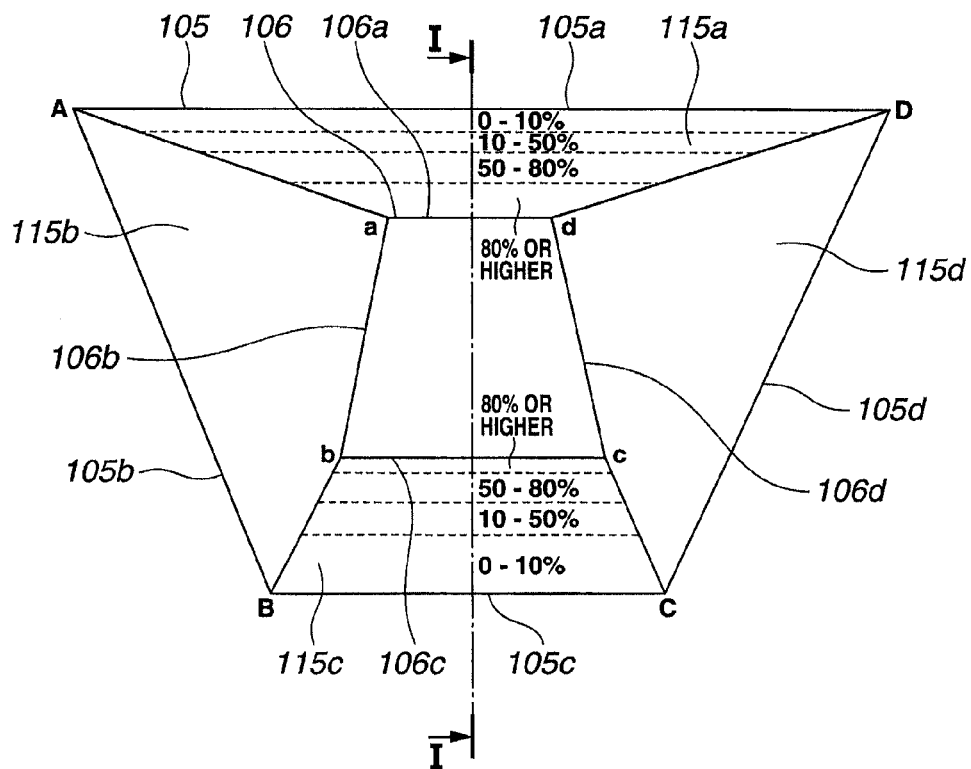
**FIG. 3A**



**FIG. 3B**



**FIG.4**



**FIG.5**

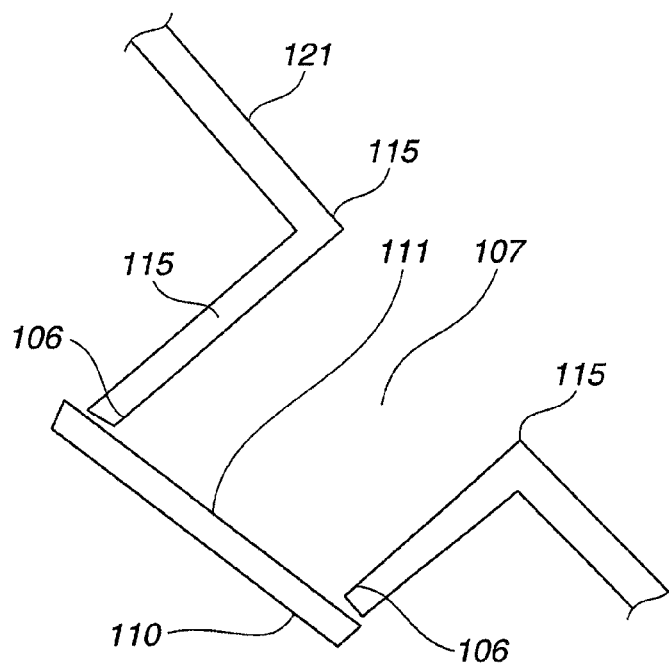
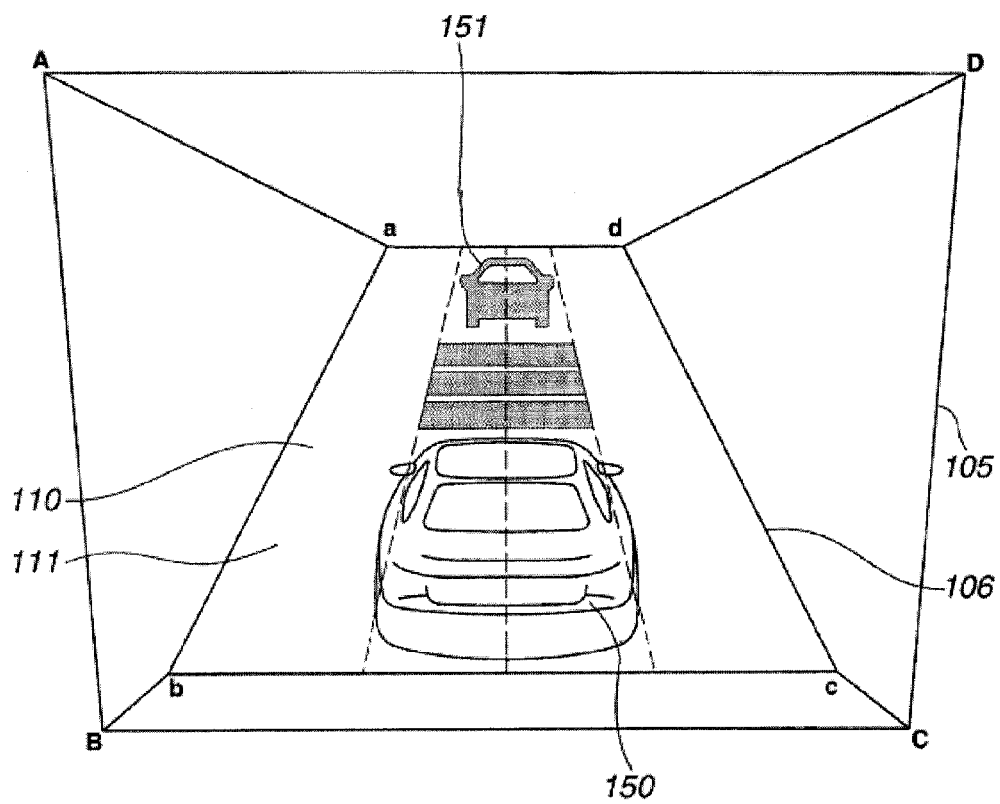


FIG. 6



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**DISPLAY APPARATUS****CROSS-REFERENCE TO RELATED APPLICATIONS**

The present application claims priority from Japanese Patent Application No. 2009-102661, filed Apr. 21, 2009. The contents of this priority application are hereby incorporated by reference in their entirety.

**BACKGROUND OF THE DISCLOSURE****1. Field of the Disclosure**

The present disclosure relates to a vehicular display apparatus provided with an image display surface for displaying imagery on a meter display surface of an instrument panel.

**2. Description of the Related Art**

Japanese Patent Application Laid-Open No. 2008-30638 discloses a vehicular display apparatus in which an image display surface is inclined at a large angle in a vehicle forward direction with respect to a meter display surface, so as to produce a perspective effect.

However, in the conventional vehicular display apparatus, a structure around the image display surface may be subject to a restriction in layout because the image display surface may be physically inclined at a large angle in the vehicle forward direction so as to enhance the perspective effect.

**SUMMARY OF THE CLAIMED SUBJECT MATTER**

In one aspect of the present disclosure, a display apparatus is provided on a surface of a panel. The display apparatus includes a quadrangular window section provided in the surface, an image display surface disposed in and recessed from the quadrangular window section, a frame configured to surround the image display surface and extend from the image display surface to the quadrangular window section, in which the frame includes an inside edge formed in a substantially trapezoidal shape having a shorter upper edge and a longer lower edge, and an outside edge formed in a quadrangular shape conforming to the quadrangular window section, in which a difference in length in a lateral direction between the shorter edge of the inside edge and an upper edge of the outside edge is set larger than a difference in length in the lateral direction between the longer edge of the inside edge and a lower edge of the outside edge.

In another aspect of the present disclosure, a display apparatus is provided on a display surface of a panel. The display apparatus includes a quadrangular window section provided in the display surface, a means for displaying an image provided in the display surface, a means for recessing configured to dispose the means for displaying an image in and recessed from the quadrangular window section, a frame configured to surround the means for displaying an image and extend from the means for displaying an image to the quadrangular window section, in which the frame includes an inside edge formed in a substantially trapezoidal shape having a shorter upper edge and a longer lower edge, and an outside edge formed in a quadrangular shape conforming to the quadrangular window section, in which a difference in length in a lateral direction between the shorter edge of the inside edge and an upper edge of the outside edge is set larger than a difference in length in the lateral direction between the longer edge of the inside edge and a lower edge of the outside edge.

In another aspect of the present disclosure, a method to display an image on a display surface of a panel is provided.

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The method includes disposing a quadrangular window on the display surface of the panel, disposing an image display surface in the quadrangular window, wherein the image display surface is recessed from the window, disposing a frame configured to surround the image display surface and extend from the image display surface to the quadrangular window section, in which the frame includes an inside edge formed in a substantially trapezoidal shape having a shorter upper edge and a longer lower edge, and an outside edge formed in a quadrangular shape conforming to the quadrangular window section, in which a difference in length in a lateral direction between the shorter edge of the inside edge and an upper edge of the outside edge is set larger than a difference in length in the lateral direction between the longer edge of the inside edge and a lower edge of the outside edge.

**BRIEF DESCRIPTION OF DRAWINGS**

Features of the present disclosure will become more apparent from the following description in conjunction with the accompanying drawings.

FIG. 1 is a rear view of a vehicle, showing a vehicular display apparatus in accordance with one or more embodiments of the present disclosure.

FIG. 2 is an enlarged view of a meter display surface, showing a vehicular display apparatus in accordance with one or more embodiments of the present disclosure.

FIG. 3 is a diagram showing shapes in detail in a vehicular display apparatus in accordance with one or more embodiments of the present disclosure.

FIG. 4 is a diagram showing a frame and an image display surface in detail in a vehicular display apparatus in accordance with one or more embodiments of the present disclosure.

FIG. 5 is a sectional view of the vehicular display apparatus in accordance with one or more embodiments of the present disclosure, taken along the line I-I in FIG. 4.

FIG. 6 is a diagram showing an image on the display surface in accordance with one or more embodiments of the present disclosure.

**DETAILED DESCRIPTION**

A construction and operation of a vehicular display apparatus according to embodiments of the present disclosure will be explained hereinafter by referring to the accompanying drawings.

The following describes construction of a vehicular display apparatus 100 according to one or more embodiments of the present disclosure. As shown in FIGS. 1 through 6, vehicular display apparatus 100 may be provided with a display surface 111 as an image display surface, and a display frame part 115 as a frame surrounding an outside edge of display surface 111. Display surface 111 may be disposed in a position corresponding to an opening 107 as a window section provided at a meter panel 120 as a meter display surface of an instrument panel 130 mounted at a front part of a vehicle body.

Meter panel 120 may be covered by a meter hood part 131. A plurality of meter sections 125, such as substantially circular meters including, for example, a speedometer and a tachometer, may be provided at a meter base surface 121 of meter panel 120.

A display 110 may be disposed on a vehicle forward side of meter base surface 121 of meter panel 120. Display surface 111 of display 110 may be composed of an LCD panel, an organic EL panel, or any other display panel known in the art which may be capable of displaying imagery in a substan-

tially trapezoidal shape having a shorter upper edge and a longer lower edge. Display surface **111** may be inclined in the vehicle forward direction with respect to meter base surface **121** so that the upper edge may be located on the vehicle forward side of the lower edge. Display surface **111** may be visually recognized from the inside of a passenger compartment through a steering opening **136** of a steering handle **135**. For example, the imagery may be in the form of a perspective view from the rear and upper side of a traveling vehicle, as shown in FIG. 6, showing an inter-vehicular distance between a host vehicle **150** and another vehicle **151** traveling ahead. The imagery may also include objects or vehicles to the side or behind the traveling vehicle, or may include other perspectives or views as necessary to provide views for a specified purpose.

Now referring to FIG. 2, display frame part **115** may be composed of four surfaces, i.e., a surface **115a** (surface AadD), a surface **115b** (surface ABba), a surface **115c** (surface bBCc), and a surface **115d** (surface dcCD). Each surface may be formed with an inclination so as to surround display surface **111**, extending from meter base surface **121** of meter panel **120** in the vehicle forward direction. Display frame part **115** may include a display frame outside edge portion **105** as an outside edge formed in a quadrangular shape which may conform to the shape of opening **107** in meter base surface **121**. Display frame part **115** may also include a display frame inside edge portion **106** as an inside edge formed in a substantially trapezoidal shape so as to surround the edge of display surface **111**. Display frame part **115** may be disposed between the upper parts of the substantially circular meter sections **125** and may extend along the outside edges of meter sections **125**.

Surfaces **115a-d** may be made of resin, plastic, metal, and/or other suitable framing materials. Further, the surfaces may have grain and/or corrugation densities that may vary across the surface, as described below. Furthermore, although described herein as grains and corrugations, surfaces **115a-d** may have alternative surfaces, such as lines, granulations, and/or other geometries and/or surface structures, without deviating from the scope of the present disclosure.

Surface **115a** (surface AadD) and surface **115c** (surface bBCc) of display frame part **115** may be provided with a gradation. Specifically, in surface **115a** (surface AadD) of display frame part **115**, the density of grains may be set to increase as followed from display frame outside edge portion **105** to display frame inside edge portion **106**. More specifically, as shown in FIG. 4, surface **115a** (surface AadD) may be divided into areas of 0-10%, 10-50%, 50-80%, and 80% or higher which may be arranged from the display frame outside edge portion **105**, so that the density of grains may increase as followed toward display frame inside edge portion **106**. The depth size of the area of 0-10% may be set the smallest; the depth size of the area of 10-50% may be set larger than that of the area of 0-10%; the depth size of the area of 50-80% may be set larger than that of the area of 10-50%; and the depth size of the area of 80% or higher may be set larger than that of the area of 50-80%. This may suppress reflection of light at display frame inside edge portion **106** of surface **115a** (surface AadD), and may allow for reflection of light at display frame outside edge portion **105** so that surface **115a** (surface AadD) may become brighter with reflection of light as followed toward meter base surface **121**.

Similar to surface **115a** (surface AadD), in surface **115c** (surface bBCc), the density of grains may be set to increase as followed from display frame outside edge portion **105** to display frame inside edge portion **106**. However, in contrast to surface **115a** (surface AadD), in surface **115c** (surface

bBCc), the depth size of the area of 0-10% may be set the largest; the depth size of the area of 10-50% may be set smaller than that of the area of 0-10%; the depth size of the area of 50-80% may be set smaller than that of the area of 10-50%; and the depth size of the area of 80% or higher may be set smaller than that of the area of 50-80%. This may suppress the reflection of light at display frame inside edge portion **106** of surface **115c** (surface bBCc), and may allow the reflection of light at display frame outside edge portion **105** so that surface **115c** (surface bBCc) may become brighter with the reflection of light as followed toward meter base surface **121**. The variation of the brightness of light by grains may make it possible to enhance the perspective effect of display surface **111**. As compared to surface **115c** (surface bBCc), the area of surface **115a** (surface AadD) in which the density of grains may be high may have a larger depth size so that surface **115a** (surface AadD) may be darker than surface **115c** (surface bBCc). This may create an illusion that surface **115a** (surface AadD) may be located farther away from a viewer with respect to meter base surface **121**, which may further enhance the perspective effect.

Display frame inside edge portion **106** may have a substantially trapezoidal shape abcd composed of an upper edge **106a** (upper edge ad) as a shorter edge, a left edge **106b** (left edge ab), a lower edge **106c** (lower edge bc) as a longer edge, and a right edge **106d** (right edge cd), where upper edge **106a** (upper edge ad) may be shorter than lower edge **106c** (lower edge bc). Display frame inside edge portion **106** may cover display surface **111** of display **110**, and may define the shape of display surface **111** that may be viewed from the inside of the passenger compartment. Because display frame inside edge portion **106** may be in the form of the substantially trapezoidal shape, display **110** may have a substantially trapezoidal shape as viewed from the inside of the passenger compartment. Although the size of display frame inside edge portion **106** may be set equal to that of display surface **111** in one or more embodiments of the present disclosure, display surface **111** may be alternatively formed larger than display frame inside edge portion **106**.

Display frame outside edge portion **105** may be composed of an upper edge **105a** (upper edge AD), a left edge **105b** (left edge AB), a lower edge **105c** (lower edge BC), and a right edge **105d** (right edge CD), which may have a substantially trapezoidal shape ABCD conforming to opening **107** where lower edge **105c** (lower edge BC) may be formed shorter than upper edge **105a** (upper edge AD). Lower edge **105c** (lower edge BC) of display frame outside edge portion **105** may be formed to extend substantially parallel to lower edge **106c** (lower edge bc) of display frame inside edge portion **106**, and may be longer than lower edge **106c** (lower edge bc). Upper edge **105a** (upper edge AD) of display frame outside edge portion **105** may be formed to be substantially parallel to upper edge **106a** (upper edge ad) of display frame inside edge portion **106**, where the length of upper edge **105a** (upper edge AD) may be longer than that of lower edge **105c** (lower edge BC) of display frame outside edge portion **105**.

With regard to the relationship between display frame outside edge portion **105** and display frame inside edge portion **106**, the difference in length in the vehicle lateral direction between upper edge **106a** (upper edge ad) of display frame inside edge portion **106** and upper edge **105a** (upper edge AD) of display frame outside edge portion **105** may be set larger than that between lower edge **106c** (lower edge bc) of display frame inside edge portion **106** and lower edge **105c** (lower edge BC) of display frame outside edge portion **105**. Furthermore, the distance from upper edge **106a** (upper edge ad) of display frame inside edge portion **106** to upper edge **105a**



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(upper edge AD) of display frame outside edge portion **105** may be set larger than the distance from lower edge **106c** (lower edge bc) of display frame inside edge portion **106** to lower edge **105c** (lower edge BC) of display frame outside edge portion **105**. Accordingly, when the inside edge and the outside edge may be visible from the inside of the passenger compartment, the visible imagery may be provided with a further enhanced perspective effect.

Moreover, as shown in FIGS. 3A and 3B, a ratio  $106e/106f$  between a width **106e** (width ef) and a height **106f** (height gh) of display frame inside edge portion **106** may be set substantially equal to a ratio  $105e/105f$  between a width **105e** (width EF) and a height **105f** (height GH) of display frame outside edge portion **105**. Furthermore, width **106e** (width ef) may be a bisector with respect to height **106f** (height gh), and may be parallel to upper edge **106a** (upper edge ad) of display frame inside edge portion **106**. Width **105e** (width EF) may be a bisector with respect to height **105f** (height GH), and may be parallel to upper edge **105a** (upper edge AD) of display frame outside edge portion **105**. Namely, display frame outside edge portion **105** may be formed portrait, when display frame inside edge portion **106** may be portrait, and display frame outside edge portion **105** may be formed landscape, when display frame inside edge portion **106** may be landscape.

The following describes advantages of one or more embodiments of the present disclosure. Because the difference in length in the vehicle lateral direction between upper edge **106a** (upper edge ad) of display frame inside edge portion **106** and upper edge **105a** (upper edge AD) of display frame outside edge portion **105** may be set larger than that between lower edge **106c** (lower edge bc) of display frame inside edge portion **106** and lower edge **105c** (lower edge BC) of display frame outside edge portion **105**, an illusion may be created that upper edge **106a** (upper edge ad) of display frame inside edge portion **106** may be appear farther away from a viewer relative to display frame outside edge portion **105**, and lower edge **106c** (lower edge bc) of display frame inside edge portion **106** may appear nearer to display frame outside edge portion **105**. This may enhance the perspective effect of display surface **111**.

Because display frame outside edge portion **105** may have a substantially trapezoidal shape with upper edge **105a** (upper edge AD) being longer than lower edge **105c** (lower edge BC), it may be possible to set the difference between upper edge **105a** (upper edge AD) of display frame outside edge portion **105** and upper edge **106a** (upper edge ad) of display frame inside edge portion **106** large, which may enhance the perspective effect.

Because the distance from upper edge **106a** (upper edge ad) of display frame inside edge portion **106** to upper edge **105a** (upper edge AD) of display frame outside edge portion **105** may be set larger than the distance from lower edge **106c** (lower edge bc) of display frame inside edge portion **106** to lower edge **105c** (lower edge BC) of display frame outside edge portion **105**, the visually recognized imagery may be provided with a further enhanced perspective effect.

Because display frame part **115** may be disposed between meter sections **125**, it may be possible to efficiently use the space therebetween.

Because display surface **111** may be inclined in the vehicle forward direction with respect to meter base surface **121** so that display surface **111** may be located farther from a viewer with respect to meter base surface **121**, a perspective effect may be provided.

Because the imagery on display surface **111** may be in the form of a perspective view from the rear side of the vehicle, with display frame part **115**, the imagery may be provided

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with a perspective effect similar to an actual perspective effect sensed in a forward view, so that the perspective effect may be provided with no abnormal feel.

In one or more embodiments of the present disclosure, vehicular display apparatus **100** may be provided at a central portion or a passenger side portion of instrument panel **130**, so as to obtain similar effects. Although opening **107** may be provided with no cover or lens in one or more embodiments of the present disclosure, the opening **107** may be provided with a transparent clear panel or a lens surface.

While the disclosure has been presented with respect to a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that other embodiments may be devised which do not depart from the scope of the present disclosure. Accordingly, the scope of the invention should be limited only by the attached claims.

What is claimed is:

1. A display apparatus provided on a surface of a panel, the display apparatus comprising:

a quadrangular window section provided in the surface;  
an image display surface disposed in and recessed from the quadrangular window section;  
a frame configured to surround the image display surface and extend from the image display surface to the quadrangular window section;

wherein the frame comprises:

an inside edge formed in a substantially trapezoidal shape having a shorter upper edge and a longer lower edge; and

an outside edge formed in a quadrangular shape conforming to the quadrangular window section,

wherein a difference in length in a lateral direction between the shorter edge of the inside edge and an upper edge of the outside edge is set larger than a difference in length in the lateral direction between the longer edge of the inside edge and a lower edge of the outside edge.

2. The display apparatus of claim 1, wherein the outside edge comprises a substantially trapezoidal shape with the upper edge longer than the lower edge.

3. The display apparatus of claim 1, wherein a distance from the shorter edge of the inside edge to the upper edge of the outside edge is longer than a distance from the longer edge of the inside edge to the lower edge of the outside edge.

4. The display apparatus of claim 1, wherein the panel comprises an instrument panel of a vehicle.

5. The display apparatus of claim 4, wherein the frame is disposed between substantially circular meters provided on the instrument panel.

6. The display apparatus according to claim 4, wherein the image display surface is inclined in a vehicle forward direction with respect to the panel.

7. The display apparatus according to claim 4, wherein an image displayed on the image display surface comprises a perspective view from a rear side of the vehicle.

8. The display apparatus of claim 4, wherein the image display surface is configured to be visible from an inside of a passenger compartment of the vehicle, and wherein the image display surface is disposed on a vehicle forward side of the window section so as to display imagery in a position corresponding to the window section.

9. A display apparatus provided on a display surface of a panel, the display apparatus comprising:

a quadrangular window section provided in the display surface;

a means for displaying an image provided in the display surface;

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a frame configured to surround the means for displaying an image and extend from the means for displaying an image to the quadrangular window section;

wherein the frame comprises:

an inside edge formed in a substantially trapezoidal shape having a shorter upper edge and a longer lower edge; and

an outside edge formed in a quadrangular shape conforming to the quadrangular window section,

wherein a difference in length in a lateral direction between the shorter edge of the inside edge and an upper edge of the outside edge is set larger than a difference in length in the lateral direction between the longer edge of the inside edge and a lower edge of the outside edge.

**10.** The display apparatus of claim **9**, wherein the outside edge comprises a substantially trapezoidal shape with the upper edge longer than the lower edge.

**11.** The display apparatus of claim **9**, wherein a distance from the shorter edge of the inside edge to the upper edge of the outside edge is longer than a distance from the longer edge of the inside edge to the lower edge of the outside edge.

**12.** The display apparatus of claim **9**, wherein the panel is an instrument panel of a vehicle.

**13.** The display apparatus according to claim **12**, wherein the means for displaying an image is inclined in a vehicle forward direction with respect to the panel.

**14.** The display apparatus of claim **12**, wherein the image display surface is configured to be visible from an inside of a passenger compartment of the vehicle, and wherein the image display surface is disposed on a vehicle forward side of the window section so as to display imagery in a position corresponding to the window section.

**15.** A method to display an image on a display surface of a panel, the method comprising:  
disposing a quadrangular window on the display surface of the panel;

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disposing an image display surface in the quadrangular window, wherein the image display surface is recessed from the window;

disposing a frame configured to surround the image display surface and extend from the image display surface to the quadrangular window section;

wherein the frame comprises:

an inside edge formed in a substantially trapezoidal shape having a shorter upper edge and a longer lower edge; and

an outside edge formed in a quadrangular shape conforming to the quadrangular window section,

wherein a difference in length in a lateral direction between the shorter edge of the inside edge and an upper edge of the outside edge is set larger than a difference in length in the lateral direction between the longer edge of the inside edge and a lower edge of the outside edge.

**16.** The method of claim **15**, wherein the outside edge comprises a substantially trapezoidal shape with the upper edge longer than the lower edge.

**17.** The method of claim **15**, wherein a distance from the shorter edge of the inside edge to the upper edge of the outside edge is longer than a distance from the longer edge of the inside edge to the lower edge of the outside edge.

**18.** The method of claim **15**, wherein the panel comprises an instrument panel of a vehicle.

**19.** The method of claim **15**, wherein the image display surface is recessed from the window in a manner to convey perspective.

**20.** The method of claim **18**,

wherein the image display surface is configured to be visible from an inside of a passenger compartment of the vehicle, and

wherein the image display surface is disposed on a vehicle forward side of the window section so as to display imagery in a position corresponding to the window section.

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